File OKD987072006

Part 4

D006 V1

BC

AIR, PESTICIDES, AND TOXICS
6TH FLOOR RECORDS CENTER
Filing Form

Circle One: New File OR Infiling

Choose from the file types below:

***AIR FACILITY*:**

(____) AR - Acid Rain

(____) CB - Confidential Business

(____) CO - Compliance

(____) EN - **Enforcement

(____) GE - General

(X) PE - Permit

(____) RA - Regulatory Applicability

(____) Other ____________________

***TSCA*:**

(____) AH - Asbestos Hazard Emergency Response Act

(____) AS or AW - Asbestos or Asbestos Worker Protection

(____) CB - Confidential

(____) FI - Site Specific

(____) FO - Non Site Specific

(____) IM - **Section 5 & 8

(____) LB - **Lead

(____) PC - **PCB

** Extension of file type (if needed): (____) ES - Enforcement Sensitive
(____) DO - Docket Number

EPCRA / SARA (____)

FIFRA (____)

No. of Volumes - 1

Current FRS Number: 110000606808 State ID: 469
(Found in EnviroFacts)

Facility Name & Physical Address: NORIT Americas Inc

6th and Hunt St
Pryor, OK 74631

Remarks: ____

Requestor=s Name & Phone Number:

Matthew Loesel – 6PD-R x8544

EPA COPY

SAGE
ENVIRONMENTAL CONSULTING

98-171-C(M-2) PSD

NORIT Americas, Inc.

Application Supplement

Sulfur Dioxide (SO_2) Best Available Control Technology (BACT) Review

Pryor Facility
Pryor, Oklahoma

March 2008

RECEIVED
MAR 13 2008
AIR QUALITY

1100 CENTENNIAL BLVD., SUITE 160 • RICHARDSON, TEXAS • 75081 • 972/480-9800 • FAX 972/480-9865

TABLE OF CONTENTS

LIST OF APPENDICES

SECTION 1
INTRODUCTION

1.1 Purpose

The purpose of this document is to provide a Best Available Control Technology (BACT) analysis for the virgin activated carbon ("VAC") production facility owned and operated by NORIT Americas, Inc. (NORIT) located in Pryor, Oklahoma (herein referred to as the "Pryor Facility".) The emission sources at the Pryor Facility that are included in this BACT analysis are the Primary and Secondary Carbonizers. The pollutant of interest with respect to the BACT analysis is sulfur dioxide (SO_2).

1.2 History

The Pryor Facility was originally constructed in the late 1970s. The equipment related to VAC production at that time included feed preparation, a single carbonizer, and two multiple hearth activation furnaces (MHFs). In 1988 the Oklahoma Department of Environmental Quality (ODEQ) authorized construction of a new carbonizer. The new carbonizer, or the primary carbonizer, resulted in a Prevention of Significant Deterioration (PSD) significant increase in SO_2 emissions (i.e., greater than 40 tons.)[1] The previous owner of the Pryor Facility (Elf Atochem) did not address PSD applicability in the permit application based on the supposition that the Pryor Facility was not a PSD major source. This was an incorrect presumption since the Pryor Facility was PSD major prior to installation of the primary carbonizer for SO_2[2]. Therefore, a PSD review for SO_2 should have been completed during the 1988 permitting action. A retrospective review appears to indicate that the PSD review should have included a review of not only SO_2 emissions from the new primary carbonizer, but also the secondary carbonizer and MHFs due to the downstream effects of the new primary carbonizer. As a result of these findings and based on the consent order dated August 6, 2007, NORIT has agreed to conduct a retroactive PSD applicability review of emissions increases associated with the Primary Carbonizer Project, including emissions from the Secondary Carbonizer and the East and West Activators.

In November 2006, NORIT added a new Waste Heat Boiler (WHB) downstream of the Secondary Carbonizer afterburners to produce steam for use at the plant. No direct or indirect emissions increases associated with the addition of this WHB were expected due to the fact that this equipment does not combust fuel and no debottlenecking occurred as a result of the addition of this equipment. The WHB as installed by NORIT generates steam through the transfer of heat from the hot exhaust stream from the Secondary Carbonizer to water flowing through a non-contact heat exchanger.

---

[1] ODEQ Operating Permit 88-105-0 issued to Elf Atochem North America listed an allowable emissions rate of 43.8 tons per year from the new primary carbonizer.

[2] Sulfur mass balance data indicated a baseline emission rate in 1986 and 1987 of 363 tons per year from the VAC process.

A Tier II Air Quality Application was submitted in December 2007 to authorize historical emissions increases in the VAC Plant previously underrepresented by the facility and to authorize the addition of particulate matter control devices to sources in the VAC Plant. As part of the retroactive PSD analysis, a review of Best Available Control Technology (BACT) must be conducted for new and modified emissions units that result in a significant net emissions increase. For BACT review purposes, it is conservatively assumed that the new or modified sources resulting from the 1988 project not only included the new primary carbonizer but also the existing carbonizer herein referred to as the secondary carbonizer. This document serves as the BACT review for the primary and secondary carbonizer at the Pryor Facility.

1.3 BACT Summary

As presented in the following sections of this report, the proposed BACT for the Pryor Facility primary and secondary carbonizers is an effective sulfur limit on the raw coal used to produce VAC relative to VAC production and product yield via an SO_2 emission cap. This will have the affect of limiting emissions from the primary and secondary carbonizer in addition to the MHFs. Because lower sulfur coal has been used by NORIT since at least 1986, accepting this limit does not result in significant actual emission reduction. However, if the emissions potential for what is believed to be industry standard coal (average 3.0% sulfur) is compared to the emissions potential of lower sulfur coal (maximum 1.5% sulfur), a 50% percent reduction in potential SO_2 emissions is "realized" given the lack of other constraints on the Pryor Facility operations. In effect, the proposed BACT results in significant proportion of SO_2 emissions that are not released to the atmosphere due to proposing an inherently lower emitting process.[3]

1.4 Contents and Overview

The subsequent sections of this report contain the following information:

- Section 2.0 contains a general overview of the VAC process at the Pryor Facility;
- Section 3.0 provides the detailed BACT analysis for the primary and secondary carbonizers;
- Section 4.0 provides the conclusions of the BACT analysis;
- Appendix A contains the results of the RBLC searches;
- Appendix B contains the detailed cost of control calculations;

[3] See calculations in Appendix B.

- Appendix C contains control equipment vendor quotes; and

- Appendix D contains other supporting information including the primary carbonizer operating permit and stack testing data.

SECTION 2
PROCESS OVERVIEW

In the VAC process, bituminous and sub-bituminous coal and pitch are unloaded into storage areas. Coal is introduced by feed screw into a vibrating dryer to partially remove excess moisture. The coal is then transported by elevator to the Dry Coal Surge Bin and onto a weigh belt before being introduced to the Bowl Mill. Pitch is introduced by elevator into the Pitch Feed Bin before entering the Bowl Mill where it is mixed with coal. The coal/pitch mixture is then moved by elevator and conveyors into one of two compactor feed bins, then by screw through the Compactors. The compacted feed is then screened to remove fines before it is introduced to the Primary Carbonizer. No changes are proposed to emissions from this equipment as part of this permit application.

The prepared feed is then moved through the Primary and Secondary Carbonizers to drive off volatile matter from the carbon base and begin the activation process. The activation is started by adding atmospheric air (oxygen) to polymerize some semi-volatiles, which rearranges the molecules and makes an amorphous crystal structure which greatly increases the surface area. The Primary and Secondary Carbonizers are indirect natural gas-fired kilns. The prepared feed is moved through the Carbonizers while non-contact heat is provided through the annular space. The non-contact combustion gases exhaust from separate stacks than the waste gases from the feed side of the Carbonizers. The exhaust gases from the kilns are then directed to afterburners and WHBs to capture heat otherwise lost to the atmosphere through the exhaust stack. The exhaust from the Secondary Carbonizer WHB is then routed to a cyclone which captures particulate matter.

Following the Primary and Secondary Carbonizer processes, the carbon feed enters one of two multiple hearth furnace-type activators (i.e., the East and West Activators) to complete the activation process. The stages of the activation process include the introduction of steam, reaction air, or heat to the feed to produce the desired effects in the structure of the carbon product. The activated carbon is cooled, screened further to separate fines, and then packaged for transport and sale.

The predominant sources of emissions during the VAC process include the exhaust gases from the raw material side of Primary and Secondary Carbonizers and the exhaust gases from the MHFs. The current emissions control for the Primary and Secondary Carbonizers and MHFs are afterburners which reduce particulate matter (PM), volatile organic compounds (VOC), and carbon monoxide (CO) emissions. NORIT also installed a multi-clone dust cyclone on the vent line following the new WHB on the secondary carbonizer to capture and collect particulate matter that previously would have been emitted to the atmosphere.

Other sources of emissions that are insignificant relative to the aforementioned sources include natural gas combustion and material handling.

SECTION 3
TOP-DOWN BACT REVIEW PROCESS

A BACT Review is required for new and modified emission units that result in a PSD net emission increase. Title 40 CFR 52.21(j)(3) codifies the BACT requirement as follows:

> "A major modification shall apply best available control technology for each pollutant subject to regulation under the Act for which it would result in a significant net emissions increase at the source. This requirement applies to each proposed emissions unit at which a net emissions increase in the pollutant would occur as a result of a physical change or a change in the method of operation."

Given the discussions above it is important to define which emission units were new or modified as a result of project. The following sections describe the scope of the 1988 project, a discussion of the new and modified sources as part of that project conducted in 2006, and a discussion of EPA policy and guidance memos that present EPA positions on BACT applicability.

3.1 Primary Carbonizer Project Scope

The scope of the 1988 project at the Pryor Facility was the installation of a new primary carbonizer. The purpose of the project was to increase VAC production capacity and allow the use of varying types of coal as VAC process feedstock. The historical project descriptions indicated that the physical changes associated with the project included the addition of the new primary carbonizer and associated material handling systems[4]. As previously presented in Section 2, the feed from the primary carbonizer was subsequently directed to the secondary carbonizer. Therefore, the feed conveyance system from the primary to secondary carbonizer was likely modified as a result of this 1988 project, arguably resulting in a modification to the secondary carbonizer.

The project description contained no discussion of other physical changes made to equipment within the VAC process. Additionally, it is not believed that there was a change in the method of operation for any downstream process after the secondary carbonizer (i.e., the MHFs). This is due to the fact that EPA does not consider a change in feedstock a change in the method of operation if the emission unit was always capable of processing the feedstock. It is apparent that the MHFs could have always processed the "new" feedstock to the extent that it was properly carbonized since there were no physical changes made to the MHFs.

[4] A copy of the Project Description from the 1988 permit application and the ODEQ Project Summary Internal memorandum is included in Appendix D.

3.2 Secondary Carbonizer Stack Waste Heat Utilization

In November 2006, NORIT added a new Waste Heat Boiler (WHB) downstream of the Secondary Carbonizer afterburners to produce steam for use at the plant. No direct or indirect emissions increases associated with the addition of this WHB were expected due to the fact that this equipment does not combust fuel and no debottlenecking occurred as a result of the addition of this equipment. The WHB as installed by NORIT generates steam through the transfer of heat from the hot exhaust stream from the Secondary Carbonizer to water flowing through a non-contact heat exchanger.

3.3 EPA Policy and Guidance on BACT Applicability

There are at least two EPA policy and guidance memorandums that address the applicability of BACT to downstream emission units.

One is the 1989 Detroit Edison policy memorandum where EPA states that "The BACT requirement applies to each 'proposed emissions unit at which a net emission increase would occur as a result of a physical change or a change in the method of operation of the unit [see 52.21(j)(3)].'"[5] The policy memorandum reviews the PSD and BACT applicability to a project to burn an alternate fuel, natural gas, in a boiler at the Detroit Edison facility. The PSD determination found that even though the boiler could not accommodate combustion of natural gas prior to January 6, 1975 and required new burner canes, burning an alternate fuel did not constitute a physical change or change in method of operation that required a BACT review. This determination was based on the presumption that only the addition of burner canes would be required to burn natural gas and EPA's historical position that "...where the individual boiler being converted is capable of accommodating the alternate fuel, BACT would not apply."

A July 28, 1983 memorandum also discussed the BACT requirement and its' applicability to upstream and downstream units. [6] The 1983 memorandum describes a process in which a pulp and paper mill installs a new bleaching plant and a larger digester. The installation of these two facilities did not itself result in an emissions increase. However, emissions at the recovery boiler downstream of the new and modified units increased. As stated in the memorandum, "Since the recovery boiler itself will not be undergoing a physical change or in the method of operation, it will not have to apply BACT."

3.4 BACT Applicability Conclusion

Given the discussions above, the scope of the BACT analysis herein covers the primary and secondary carbonizers. The MHFs are not subject to BACT review because they did not experience a physical change or change in the method of operation as a result of the addition of the primary carbonizer. The primary carbonizer was installed to serve two important process functions: feed pre-treatment and commencing the initial oxidation and carbonization

---

[5] 1989 Detroit Edison PSD Policy Memorandum authored by Gerald Emison, EPA.

[6] PSD Applicability Pulp and Paper Mill authored by Edward Reich dated July 28, 1983.

processes. The addition of the primary carbonizer allowed NORIT to achieve a higher overall process yield and process a wider variety of coal. Even if the ability to process a wider variety of coal is believed to modification, EPA's historical stance has been that if the emission unit being converted is capable of accommodating the alternate material without significant physical modifications then BACT does not apply.

3.5 Overview of Top-Down BACT

The United States Environmental Protection Agency (US EPA) endorses the top-down approach to BACT analysis. Under this approach, BACT is defined at the best control technology that is currently available as determined on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs of alternative control systems.

The top-down BACT evaluation begins by identifying the possible control technologies. Then the technically infeasible options are eliminated from consideration and the remaining options are ranked based on control effectiveness. The most effective controls are evaluated and the results documented. The evaluation process consists of evaluating each control option, taking into account energy, environmental, and economic impacts. The options are evaluated in rank order. The most effective option not rejected is then selected as BACT. A detailed discussion of each step is presented in the following sub-sections.

3.6 Step 1 - Identify All Available Control Technologies

The top-down BACT approach commences with the identification of all available control technologies for the emissions unit in question. For the purposes of BACT analysis, the term emissions units "...should read to mean emission unit, process, or activity..." Available control options should include "...those with a practical potential for application to the emissions unit for the regulated pollutant under evaluation."[7] The identification of available control technologies should include existing control technologies for the emission unit under evaluation as well as controls applied to similar source categories. Innovative technologies and technologies that represent the lowest achievable emission rate (LAER) are considered available control technologies. Fuel treatment or innovative combustion techniques as well as processes that are inherently lower-polluting are also considered available control options for top-down BACT review.

3.7 Step 2 – Eliminate Technically Infeasible Technologies

In the second step of a top-down BACT review, the technical feasibility of the controls options is evaluated on a source-specific basis. "A demonstration of technical infeasibility should be clearly documented and should show, based on physical, chemical, and engineering principles, that technical difficulties would preclude the successful use of the

[7] New Source Review Workshop Manual Prevention of Significant Deterioration and Nonattainment Area Permitting, Chapter B – Best Available Control Technology, page B.5.

control option on the emission unit under review."[8] Technically infeasible options are eliminated from further consideration.

3.8 Step 3 – Rank Remaining Control Options by Control Effectiveness

In the third step, all remaining control technologies are ranked by overall control effectiveness. Each control option and its control efficiency, expected emission rate, expected emission reduction, economic impacts, environmental impacts, and energy impacts is presented in this step.

3.9 Step 4 – Evaluate Most Effective Controls and Document Results

Based on the rank order developed in Step 3, the most effective control is evaluated based on its energy, environmental, and economic impacts. If the top control is eliminated as BACT, the next control option is selected and similarly evaluated. "This process continues until the technology under consideration can not be eliminated by any source-specific energy, environmental, or economic impacts which demonstrate that alternative to be inappropriate as BACT."[9]

3.10 Step 5 – Select BACT

In this step the most effective control not rejected in Step 4 is selected as BACT.

[8] New Source Review Workshop Manual Prevention of Significant Deterioration and Nonattainment Area Permitting, Chapter B – Best Available Control Technology, page B.7.
[9] New Source Review Workshop Manual Prevention of Significant Deterioration and Nonattainment Area Permitting, Chapter B – Best Available Control Technology, page B.9.

SECTION 4
DETAILED TOP-DOWN BACT REVIEW

This section presents the results of the top-down BACT review for the Primary and Secondary Carbonizers and MHFs at the Pryor Facility. The review is organized to follow the step-wise, top-down approach endorsed by EPA and required by ODEQ and outlined in Section 3.

4.1 Step 1 – Identification of All Available Control Options

In order to identify available control technologies, EPA's clearinghouse was searched to identify recent permitting actions and recent BACT determinations. The clearinghouse is commonly known as the RBLC or RACT/BACT/LAER clearinghouse. As the name implies, this clearinghouse includes determinations of reasonably achievable control technology (RACT), best available control technology (BACT) and the lowest achievable emission rate (LAER) in recent permitting actions. First the clearinghouse is searched for the BACT determinations for the same emission unit and same process, then, for similar emission units and similar processes. As a final step, additional permitting files are reviewed to identify determinations that are not recorded in the database.

4.1.1 Same Emission Unit / Same Process

The clearinghouse was first searched for the emission units and processes included in this BACT review with respect to sulfur dioxide controls. Search terms included:

- carbonizer;
- activated carbon;
- activation;
- activation furnace; and
- carbon

Only the search for "activation furnace" returned any results. However, the results were for munitions and explosives "deactivation furnaces" and "Cat Reactivation Furnace" which is not a similar process or emission unit.

4.1.2 Similar Processes

Next, similar processes were identified. For the purposes of this BACT review four "similar" processes were identified: carbon black manufacture, calcined coke manufacture, petroleum (needle) coke manufacture, and clay brick manufacture.

4.1.2.1 Carbon Black Industry

The carbon black industry is similar to VAC production process in that a carbonaceous feedstock is heat treated to create a saleable product (carbon black) that exhibits certain desired chemical properties. In the carbon black process, heavy oil is thermally reacted resulting in significant quantities of waste gas or tail gas. The tail gas contains a significant quantity of reduced sulfur compounds that are driven from the sulfur in the feedstock. In order to reduce the quantity of reduced sulfur compounds emitted to the atmosphere, the tail gas is subsequently combusted in thermal oxidizer, flare or other combustion device in a manner similar to the way the exhausts from the VAC process are combusted in the afterburners. The combustion of the sulfur compounds results in a significant quantity of SO_2 emissions. The SO_2 emissions from the carbon black process are typically orders of magnitude higher than those seen in the VAC production process and add-on SO_2 emission controls have not been required by regulatory agencies[10] or the recent federal regulations promulgated by EPA[11]. Therefore, additional add-on control may not be required for the waste gases from the VAC production process to meet BACT.

4.1.2.2 Calcined Coke Industry

The calcined coke industry is also similar to the VAC process in that a carbonaceous feedstock is processed in calciners at high temperature to drive off excess moisture and to create a dried product (calcined coke) that exhibits desired chemical properties. In the calcined coke process, petroleum coke from refinery coker units is used as the feedstock. The petroleum coke typically contains significant quantities of bound sulfur that is driven off during calcining. The resulting tail gases from this process, therefore, contains significant quantities of SO_2 that are orders of magnitude higher than those seen in the VAC production process and add-on SO_2 control is not used in this industry. Therefore, additional add-on control may not be required for the waste gases from the VAC production process to meet BACT.

4.1.2.3 Petroleum Coke Industry

The petroleum coke industry is also similar to the VAC process in that a carbonaceous feedstock is processed in kilns at high temperature to drive off excess moisture and to create a dried product (needle coke) that exhibits desired chemical properties. In needle coke manufacturing, petroleum coke from refinery coker units is used as the feedstock. The petroleum coke typically contains significant quantities of bound sulfur that is driven off in the kilns. The resulting tail gases from this process, therefore, contain significant quantities of SO_2 that are orders of magnitude higher than those seen in the VAC production process.

---

[10] One example is Texas Commission on Environmental Quality (TCEQ) Air Permit P416M1. This was a PSD permit issued to Degussa Engineered Carbons for their Borger, Texas facility. No add-on emission controls for SO_2 were required as part of the BACT review for this permit action.
[11] Title 40 CFR Part 63, Subpart YY.

Likewise for the petroleum coke industry, add-on SO_2 control is not used. Therefore, additional add-on control may not be required for the waste gases from the VAC production process to meet BACT.

4.1.2.4 Clay Brick Industry

Finally, the brick industry is similar to the VAC production process in that nonmetallic minerals are used a feedstock. In the brick industry, clays (which are often mined in geologic formations that contain coal) are wetted and formed into bricks then fired in kilns at high temperature to drive off moisture from the brick and create the final product. In a similar manner to the VAC process, the clay raw material used for brick production contains sulfur which is driven off during the firing process resulting in SO_2 emissions. SO_2 emissions from brick production are generally the same order of magnitude as those in the VAC process.

As in the VAC industry, the brick industry is a "low margin" industry and the installation of add-on controls may compromise the economic viability of a plant. Although many brick plants do not have add-on controls for SO_2, a recent MACT standard promulgated by EPA[12] has identified the need for hazardous air pollutant (HAPs) control from the brick kilns. One of the control technologies used, "dry lime injection" or "dry lime scrubbing", also provides for SO_2 control. In this control technology dry lime is added to the waste gases to react with the acid gases (hydrofluoric acid (HF) and hydrochloric acid (HCl)) in the waste stream. Although dry lime injection is primarily for HF and HCl control, there is also a realized SO_2 control efficiency.

4.1.2.5 RBLC Clearinghouse Review

The RBLC clearinghouse was searched for BACT determinations for the similar processes described above using the following search terms.

- calciner;
- brick manufacturing;
- calcined carbon;
- calcined coke; and
- carbon black

The search returned results for "carbon black" and "calciner". The Cabot Corporation operates a carbon black reactor that is controlled for emissions of sulfur oxides by limiting the sulfur in the carbon black oil feedstock to three percent (3%) on an annual basis. In this case, the use of a low sulfur feedstock constitutes a sulfur oxide "control device" via pollution prevention and was determined to be BACT-PSD on December 28, 2004.

[12] Title 40 CFR Part 63, Subpart JJJJJ.

The search for "calciner" provided results from the cement manufacturing industry. The results showed operations of preheaters and calciner dryers that controlled emissions of sulfur oxides with the use of either a scrubber or low sulfur in the feedstock. In this case, the use of a low sulfur feedstock constitutes a sulfur oxide "control device" via pollution prevention and was determined to be BACT-PSD on December 28, 2004.

The results of the RBLC clearinghouse searches are provided in Appendix B.

4.1.3 Similar Emissions Units

The next step consists of searching the EPA RBLC database for similar emissions units. Due to the unique nature of the thermal VAC production process, the RBLC database does not include any "similar" emission units. Therefore, for the purposes of this BACT analysis, a coal fired boiler was considered as a similar emission unit to the VAC process, although there are fundamental differences between carbonizers and coal fired boilers. The primary difference is that in a coal fired boiler the coal is almost completely consumed to provide heat which liberates all of the coal bound sulfur. In VAC manufacturing, the process seeks to preserve the majority of the carbon in the coal and achieve the desired structure and sulfur remains in the finished VAC product. The second difference is the capacity of coal fired boilers as compared to the carbonizers and activation furnaces. The final difference is in the emissions potential. Large coal fired boilers are expected to have a significantly higher emissions potential because the coal consumption of one 250 MMBtu/hr coal fired boiler (approximately 73,000 tons) is almost double the amount of coal purchased by NORIT in 2005 (approximately 42,000 tons). The difference in emissions potential is significant not only on a mass emissions basis, but also on a pollutant concentration basis in that the exhaust from coal fired boilers is expected to have higher sulfur content than the exhaust from VAC processes making certain control methods more feasible.

4.1.3.1 RBLC Clearinghouse Review - Large Utility Boilers/Furnaces

Despite these differences, coal fired boilers and VAC manufacturing both use coal as a raw material and the RBLC was searched for BACT determinations for coal fired boilers. It was assumed that sulfur dioxide controls on coal fired boilers and furnaces could potentially transfer to NORIT's processes. Of the results returned for process type 11.110, 'Coal Fired Large Utility Boilers / Furnaces' (capacity greater than 250 million British thermal unit per hour (MMBtu/hr)), 37 coal fired boilers were identified in the RBLC database. The sulfur oxides controls and/or control technologies that were determined to be BACT-PSD at the time of permitting action were:

- 10 boilers with limestone injection / dry flue gas desulfurization;
- 2 boilers with a combined emission limit, limestone injection, and CEMS;
- 3 boilers with a wet scrubber;
- 3 boilers with a limit on the sulfur content of the coal;
- 1 boilers with a limit on the sulfur content of the coal and limestone injection:

- 3 boilers with limestone injection with fly ash reinjection;
- 3 boilers with the option of limestone injection followed by a spray dryer;
- 1 boilers with dry flue gas desulfurization and CEMs
- 2 boilers with Flue Gas Desulfurization system with a fabric filter; and
- 1 boiler with spray dryer absorber

The remaining 8 boilers under the large utility boilers process type were not specifically noted as having sulfur dioxide control required as BACT-PSD. These determinations were either marked "N/A", "NSPS", or "Other" based on case-by-case determination. The controls and/or control technologies on these boilers were:

- 1 boilers with limestone injection and fuel sulfur limits
- 1 boiler with fly ash reinjection
- 2 boilers with Dry flue gas Desulfurization System (Wet scrubbing)
- 2 boiler with good combustion practices by limiting the sulfur content in the fuel
- 2 boiler with a limestone fluidized bed

4.1.3.2 RBLC Clearinghouse Review – Industrial Sized Boilers/Furnaces

A search was also performed on industrial sized boilers and furnaces (capacity between 100 and 250 MMBtu/hr) that were included in the RBLC database. The search returned six boilers in this category with the following controls determined to be BACT-PSD at the time of the permitting action:

- 2 boilers with limestone injection / flue gas desulfurization;
- 2 boilers with a wet scrubber; and
- 2 boilers with no feasible controls.

4.1.3.3 RBLC Clearinghouse Review – Commercial and Institutional Boilers/Furnaces

Finally, a search was conducted for commercial / institutional size boilers (capacity less than 100 MMBtu/hr). No search results were returned for this category.

The results of the RBLC clearinghouse searches are provided in Appendix B.

4.1.4 Review of Additional Permit Documentation

Because the results of the RBLC searches were very limited, additional permitting documentation for the VAC process and similar processes was reviewed. The documentation reviewed includes supporting permit documentation that is publicly available. The results of this review are presented in the following subsections.

4.1.4.1 Virgin Activated Carbon Manufacturing

Because the thermal VAC process is relatively unique in the United States, it was not surprising that the RBLC clearinghouse did not contain VAC emission units or process specific BACT determinations. At the time of this BACT review, only three United States facilities use the thermal re-agglomeration (TA) process to produce VAC. The TA VAC production facilities in the United States include the Calgon Carbon Corporation's Catlettsburg, Kentucky and Bay St. Louis, Mississippi facilities, and the Pryor Facility. As previously mentioned, the RBLC clearinghouse did not contain any determinations for these facilities. Therefore, additional publicly available permit documents outside of the RBLC clearinghouse were reviewed.

The permitting information gathered for the Calgon facilities indicated that carbonizers at both facilities are equipped with wet scrubbers. As an additional point of reference, NORIT also owns and operates a thermal VAC process in Marshall, Texas. Although VAC is produced by a thermal process at the Marshall Facility, the process is inherently different in that it is a direct activation process not a re-agglomeration process. The Marshall facility is also included in this analysis.

The Title V Permit for the Calgon Catlettsburg Facility represents a 75% SO_2 control efficiency for bakers (i.e., carbonizers) that are equipped with wet scrubbers[13]. The Calgon Bay St. Louis facility Title V Permit does not explicitly list the SO_2 control efficiency[14]. However, it would be expected that the wet scrubbers at the Calgon Bay St. Louis facility would achieve a similar control to that represented for the Calgon Catlettsburg facility given discussions with controls vendors.

It should be noted that the Calgon Catlettsburg Facility is located in a portion of Boyd County, Kentucky that has been designated as an SO_2 non-attainment area. The language in the Calgon Catlettsburg Facility Title V permit statement of basis[15] indicates that the scrubbers were installed for the purpose of demonstrating compliance with the SO_2 National Ambient Air Quality Standards (NAAQS), not for the purposes of meeting BACT. A review of the Sulfur Dioxide Redesignation Request prepared by the Kentucky Division of Air Quality and submitted to the U. S. EPA in November 2004, confirms that the decrease in allowable emissions resulting from the installation of wet scrubbers from Calgon's Catlettsburg facility was the primary reason Boyd County was re-designated as attainment for SO_2[16]. This seems to indicate that the controls were installed for air quality standard attainment purposes, not for the purposes of BACT.

---

[13] Commonwealth of Kentucky Division of Air Quality, Permit Statement of Basis Title V Permit Number V-00-020, July 13, 2006,Renewal.
[14] Mississippi Department of Environmental Quality Title V Permit Number 1000-00015
[15] Commonwealth of Kentucky Division of Air Quality, Permit Statement of Basis Title V Permit Number V-00-015, Revision 2, April 27, 2004, page 8.
[16] Sulfur Dioxide Redesignation Request and Maintenance Plan SIP Revision for Boyd County, Kentucky, November 2004.

As an additional point of reference, the NORIT Marshall VAC process has add-on SO_2 control. However, most of the add-on SO_2 controls pre-date not only PSD / BACT regulations, but also Clean Air Act regulations. With one exception, the scrubbers were installed in the 1960s and 1978. The scrubber on the activation furnace was installed in approximately 1992. However, it was not installed as the result of PSD permitting or a BACT determination. These scrubbers provide PM control in addition to SO_2 control. The Marshall facility typically processes coal with a sulfur content of 1-1.5%.

Therefore, of the four VAC facilities discussed herein, three facilities have add-on SO_2 emission control. One of those facilities appears to have added the wet scrubbing technology for NAAQS compliance – presumably as Lowest Achievable Emission Reduction (LAER) technology under the Nonattainment New Source Review (NNSR) regulations or attainment demonstration purposes under the Kentucky State Implementation Plan (SIP). The Marshall facility utilizes wet scrubbing for add-on SO2 controls because it is a historical technology for the facility. The use of this add-on SO_2 control does not appear to be due to PSD permitting or as the result of a BACT review. The discussions above define wet scrubbing as an available control option.

4.1.4.2 Similar Processes Permit Documentation

Because the RBLC searches for similar processes returned only one determination, additional permit documentation was reviewed to identify controls in place for similar processes. This review identified three additional permitting actions that are relevant to this BACT analysis.

A permitting action for the Cabot Carbon Black facility in Pampa resulted in an emissions increase of 4,083 tpy of SO_2. The emissions units at this facility are not equipped with SO_2 controls. Instead, this permitting action limited sulfur content in the feedstock to 3.75%[17]. The emissions potential for this facility is 2.5 times the proposed potential-to-emit emissions rate represented in the December 2007 Pryor facility Tier II Air Quality Permit application. While the results of the BACT analysis conducted for this facility are not readily available, technical staff involved in the project recall the cost of control for a scrubber was approximately $10,000 per ton.

Additionally, permits for Oxbow Carbon LLC in Port Arthur, Texas reference four sulfur limits in their feedstock. The limits are 3%, 4%, 4%, and 4.5%. This facility processes almost one million pounds of green coke a year at a sulfur content of 3 to 4.5% . In 2006, Oxbow restored the emission rates for Process Kiln 5 with a submittal of a Pollution Control Project standard permit in which authorizes the emissions of this facility to exceed 19,000 tons of SO_2 per year. This emissions potential is based on a review of the Maximum Allowable Emissions Rate Table (MAERT) for Texas Commission on Environmental Quality (TCEQ) permit numbers 5421 and 45622[18],[19]. The processing capacity of this

[17] TCEQ permit number 42233 / PSD-TX-956 for Cabot Corporation, Pampa, TX dated May 16, 2002.
[18] TCEQ Permit number 45622 for Great Lakes Carbon Corporation, dated August 1, 2007.
[19] TCEQ Permit number 5421 for Great Lakes Carbon Corporation dated August 1, 2007.

facility is almost two orders of magnitude greater than the Pryor Facility and the emissions potential is over 11 times the current emissions at the Pryor Facility and no add-on SO_2 controls are required. Rather, feedstock sulfur content is limited.

The review of additional permit documentation for similar processes revealed that BACT for these processes is accepting a sulfur limit in the feedstock coupled with a capacity limitation. These facilities process significantly more raw material and have a significantly higher emissions potential than Pryor Facility and add-on SO_2 controls have not been required.

4.1.5 Available Control Technologies

Based on the review of BACT determinations archived in the RBLC clearinghouse as well as additional permitting documentation, the following list of available control technologies was generated.

- limestone injection / lime scrubber / dry flue gas desulfurization;
- wet scrubber; and
- limit on feedstock sulfur content

These control technologies will be reviewed throughout the rest of the top-down BACT review.

4.2 Step 2 – Eliminate Technically Infeasible Options

While several of the available control options are technically challenging or have significant adverse economic or environmental impacts, none of them are technically infeasible. The adverse impacts are discussed in detail in Section 4.4.

4.3 Step 3 – Rank Remaining Control Options Based on Effectiveness

In summary, the control options are ranked as follows from an emission control perspective: (1) wet scrubbing, (2) dry scrubbing, and (3) feedstock sulfur limitation. A discussion of the effectiveness of each control option is presented in the following sections.

4.3.1 Wet Scrubbing

Wet scrubbing can achieve a 75% to 90% reduction in sulfur oxides control, making wet scrubbing the most effective control technology. The 75% to 90% control efficiencies are based on an evaluation of wet scrubber control efficiencies represented in recent permit applications, literature reviews, and provided by control equipment vendors. The fact that wet scrubbing is the most effective control is supported by the fact that the Title V permit for Calgon Catlettsburg Facility appears to indicate that wet scrubbing represents Lowest Allowable Emission Rate (LAER) technology.

For the purposes of this BACT review, two wet scrubbing configurations were evaluated. The configurations included individual scrubbers on each carbonizer stack and a second configuration to install a common scrubber to service both carbonizers. In addition, given the high wastewater treatment costs for scrubber blowdown, an innovative wet scrubbing technology known as dual alkali scrubbing was evaluated based on the same configurations above. The vendor indicated that this dual alkali system can also achieve the 90% control efficiency without generating any wastewater blowdown.

4.3.2 Dry Scrubbing

The next most effective add-on control technology was determined to be limestone injection or dry limestone scrubbing. Based on vendor quoted efficiencies, an overall sulfur dioxide control efficiency of 50% may be expected for limestone scrubbing for the NORIT Pryor facility VAC process. This efficiency was determined by vendors based on the SO_2 concentrations in the carbonizer and furnace exhaust measured during the June 2004 NORIT Pryor VAC process stack test. The lower control efficiency for dry lime scrubbing as compared to wet scrubbing was indicated by control equipment vendors to be a function of the relatively low SO_2 concentrations in the carbonizer and furnace exhaust as compared to typical vent streams controlled by limestone injection.[20] For the purposes of this review, dry scrubbing configurations were evaluated that included individual scrubbers on each carbonizer stack and a second configuration to install a common scrubber to service both carbonizers.

4.3.3 Feedstock Sulfur Limit

Although not an add-on control technology, limiting the coal feedstock sulfur content for VAC manufacture was evaluated as potential BACT. The feedstock characteristics for thermal VAC processes are not publicly available due to the proprietary nature of VAC manufacture. However, anecdotal information indicates that the feedstock at one of the Calgon facilities contains an average of 1.5% sulfur[21]. Additionally, the RBLC clearinghouse contains records of BACT determinations that limited the sulfur content of the coal fired in carbon black manufacture to 3%[22]. Finally, as a third point of reference, the current coal feedstock sulfur content for the Pryor contains an estimated average feedstock sulfur content of approximately 1%. Since the sulfur content of the feedstock currently used at the Pryor Facility appears to be the most stringent between the feedstock limits indicated for other facilities, it will be evaluated during the following steps of the BACT analysis.

4.4 Step 4 – Evaluate Most Effective Controls

According to top-down BACT protocol, the control options must be evaluated from most to least stringent control option. The most stringent control option that is not rejected is determined to be BACT. This section documents the review of the control options in the rank order determined in Step 3.

---

[20] O'Brien and Gere, Norman, Jon P. E., Budgetary Cost Estimate for Installation of Lime Slurry Injection Systems dated June 23, 2005 and verified January 16, 2006.
[21] The Calgon Catlettsburg facility purportedly uses New Zealand coal at 1.5% sulfur.
[22] The RBLC clearinghouse showed that a 3% sulfur limit in the feedstock was accepted as BACT as recently as December 28, 2004 for the Cabot Corporation, Pampa Facility.

4.4.1 Wet Scrubbing

Wet scrubbing to reduce sulfur dioxide emissions appears to be LAER and is the most stringent control option. While the wet scrubber may achieve the highest level of control efficiency, installation of a wet scrubber at the Pryor Facility presents several challenges. Due to the locations of the two carbonizers to be controlled, either a scrubber must be installed on each carbonizer exhaust stack or a common ducting system must be constructed. The cost for the common ducting could likely be substantial and would require detailed engineering configuration of the site specific factors to accurately estimate costs associated with a single scrubber. A more detailed discussing of the environmental and economic factors associated with a wet scrubber is presented in the sections below.

4.4.1.1 Environmental Impacts

The environmental drawbacks to wet scrubbing are the generation wastewater in the form of scrubber blowdown and the scrubber sludge that is generated. The blowdown issue is magnified for the Pryor Facility in that they discharge their wastewater to the existing publicly owned treatment works (POTW). In the past, the Pryor Facility faced challenges related to the selenium content in their wastewater. Selenium is a known aquatic toxic and discharges of selenium from the Pryor Facility and the POTW are restricted via permit limits. The wastewater resulting from wet scrubbing would likely increase the selenium loading to the POTW. In addition to requiring re-permitting for the Pryor Facility, the additional discharges of selenium may push NORIT's POTW, OOWA, to their permit limit for selenium. The Pryor Facility would essentially utilize all remaining selenium capacity as a result of installing a wet scrubber. It is unlikely that NORIT could successfully re-permit the Pryor Facility and continue to discharge to OOWA without major modifications.

Wet scrubbing also has several drawbacks from an emission control perspective. Wet scrubbing technology may generate additional PM emissions on the order of 1% associated with the solids created as a result of reaction between the scrubbing medium and the treated waste gas. Furthermore, the wet scrubbing technology may create particulate matter in the form of condensables with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), thereby creating additional air quality concerns given US EPA's proposed $PM_{2.5}$ NAAQS. Finally, although wet scrubbing may be effective in reducing SO_2 emissions, an unintended effect of wet scrubbing, depending on the scrubbing medium is the potential production of sulfuric acid mist (H_2SO_4) due to the reaction of SO_2 with water.

Dual alkali scrubbing technology could be utilized to mitigate some of the negative environmental impacts of wet scrubbing. However, it too carries a negative environmental impact. A significant volume of filter cake is generated and requires on-site handling and off-site treatment and disposal. A discussion of the economic impacts associated with wet scrubbing is presented in the following section.

4.4.1.2 Economic Impacts

Wet scrubbing is used as add-on SO_2 control at some of the VAC plants in the United States. However, the annualized costs associated with the wet scrubbing at the Pryor Facility appear to be prohibitive from an economic perspective. The technology is fraught with significant operating costs due to the need to dispose of the wastewater and wastewater solids generated, the cost to purchase water as the scrubbing medium, water availability, the electricity required for pumping wastewater, and general maintenance required on a wet scrubber due to a propensity to "foul". In addition, the capital costs associated with wet scrubbing are high due to the infrastructure needed for wastewater collection and treatment, the large footprint of the wet scrubbing equipment, and chemical handling facilities.

As mentioned above, the current design and configuration of the Pryor Facility cannot accommodate the scrubber effluent generated as a by-product of wet scrubbing and meet POTW pre-treatment standards. Additional infrastructure would be needed for wastewater collection and treatment. When the cost of the infrastructure required to handle and treat the scrubber effluent is added to the cost of the scrubber, the capital investment required for the wet scrubber significantly increases. Although a detailed design was not prepared for the necessary wastewater treatment plant installations, the costs for wastewater treatment equipment are expected to be as expensive as the cost of the scrubbers themselves.

One vendor that was queried provided a quoted cost for a wet scrubber for the combined case of the carbonizers at the Pryor Facility of \$370,000. This cost did not include operating costs or the cost to install a common ducting system. The annualized cost of control for a common scrubber in turn was calculated to be \$766,916, not including the cost of the common ducting. The annualized costs of control to install a scrubber on the primary and secondary carbonizers are \$440,733 and \$433,539, respectively. The resultant cost-effectiveness for these two control schemes is \$3,738 per ton and \$1,230 per ton, respectively. This cost is considerably lower that what would be expected since the cost analysis was generated on caustic costs from 2006. Detailed calculations for the annualized cost and cost effectiveness are presented in Appendix B. As previously mentioned the costs above do not take into consideration the costs for any modification that may be required if selenium levels are increased. Note that the 75% scrubber control cost is not discussed since it is insignificant. Detailed calculations for the annualized cost and cost effectiveness for the wet scrubbing technology are contained in Appendix B.

As mentioned above, innovative scrubbing technology was considered in light of the significant challenges of handling, treating, and discharging scrubber effluent. A dual alkali scrubber was evaluated that eliminates wastewater blowdown. Instead of scrubber wastewater effluent, the unit generates a solid filter cake that must be treated and / or disposed. The dual alkali scrubber vendor provided a cost quote of \$1,050,000 for a single dual alkali scrubber to control the combined waste stream from Pryor Facility primary and secondary carbonizers. It should be noted that this cost did not include operating costs or the cost to install a common ducting system, which would increase the capital cost and resultant annualized cost. Without the aforementioned considerations for common ducting or equipment for filter cake management, the annualized cost of control for a common dual alkali scrubber was calculated to be $968,152 which relates to a cost effectiveness of $2,059. The annualized costs of control to install a dual alkali scrubber on the primary and secondary carbonizers separately were calculated to be $848,460 and $820,618, respectively, which relates to a cost effectiveness of $7,196 and $2,329, respectively. Detailed calculations for the annualized cost and cost effectiveness are presented in Appendix B.

A review of the RBLC clearinghouse indicated that cost effectiveness data is not recorded for the majority of the determinations archived in the database and none of the RBLC determinations that identified wet scrubbing as the control device included cost effectiveness data. Of the dry scrubbing / lime scrubbing RBLC entries, only seven determinations included cost effectiveness data. All seven determinations were for industrial sized coal fired boilers with capacities between 100 and 250 MMBtu/hr. The cost effectiveness ranged from $500 per ton to $644 per ton. These reported RBLC costs are almost an order of magnitude less than those calculated for a wet scrubber at the Pryor Facility even without consideration of wastewater modifications and additional ductwork that may be required. A summary of the RBLC determinations that contained cost effectiveness data is included in Appendix A.

Based on review of the site-specific energy, environmental, and economic impacts, wet scrubbing is rejected as BACT for the carbonizers at the Pryor Facility.

4.4.2 Lime Scrubbing

The next most stringent control option is scrubbing via limestone injection. This technology is commonly used as an effective control technology in coal fired boilers. However, given the low concentrations of SO_2 in the VAC process the level of control achieved is significantly less than that would be achieved through wet scrubbing. The following section discusses the environmental and economics impacts associated with limestone injection.

4.4.2.1 Environmental Impacts

Lime scrubbing generates a significant solid waste stream. Depending on which sources are controlled, the solid waste stream generation rate may range between 40 and 159 tons per year. This would result in an additional environmental impact in that the waste stream may require landfill or other disposal methods.

4.4.2.2 Economic Impacts

The limestone injection control equipment vendor provided a cost quote of $775,000 for a single limestone injection system to control the combined waste stream from Pryor Facility primary and secondary carbonizers. It should be noted that this cost did not include operating costs or the cost to install a common ducting system which would increase the capital cost and resultant annualized cost associated with a single control system. Without the aforementioned considerations for common ducting and equipment for spent lime management, the annualized cost of control for a common limestone injection system was calculated to be $737,348 which relates to a cost effectiveness of $2,822. The annualized costs of control to install a limestone injection system on the primary and secondary carbonizers separately were calculated to be $615,107 and $624,119, respectively, which relates to a cost effectiveness of $9,391 and $3,188, respectively. Detailed calculations for the annualized cost and cost effectiveness for the limestone injection control technology are contained in Appendix B.

As previously indicated, the cost effectiveness data available in the RBLC clearinghouse reveals several determinations that included cost effectiveness data for dry scrubbing systems. The average cost effectiveness for theses systems was $500 per ton. The estimated cost presented for any of the limestone injection control scenarios above, without additional site specific considerations that would increase the capital and annualized costs, are more than an order of magnitude higher than the cost effectiveness indicated as BACT in the RBLC clearinghouse.

Based on taking into account the site-specific economic and environmental impacts, lime scrubbing is rejected as BACT for the carbonizers at the Pryor Facility -- primarily as a function of the high cost of control

4.4.3 Limiting Sulfur Content in Raw Coal

Although an effective limit on the sulfur content in the VAC process feedstock is not an add-on control, it is a manner of reducing potential SO_2 emissions. Recent permitting determinations have defined a sulfur limitation from certain processes as BACT. This was previously discussed in the review of the carbon black industry in Sections 4.1.3 and 4.3, where a 3% sulfur limit in carbon black feedstock was accepted as BACT as recently as December 28, 2004. Additionally, recent BACT determinations for coal fired boilers reflected in the RBLC clearinghouse indicate that limiting the sulfur content of feedstock to 1.2% was considered to BACT as recently as March 2005.

The effective emission reduction that is achieved through limiting the coal sulfur content would generally be based on the sulfur content of the previous raw material as compared to the proposed raw material. In the case of the Pryor Facility, it appears that lower sulfur coals have been in use since at least 1986, with the feedstock coal containing an average of approximately 1.0% sulfur. These sulfur levels are consistent with recent BACT determinations; this implies that the Pryor Facility VAC process already meets BACT.

Based on this review, accepting a limit on the sulfur content of the coal feedstock would satisfy the BACT requirements without any additional, economic, environmental or energy constraints except to the extent that the costs that NORIT pays for their coal appears to be higher than that for the VAC industry standard coal. The 1.5% maximum sulfur content of the coal in use at the Pryor Facility is equal to the current thermal VAC industry standard and less than the sulfur content limit in carbon black manufacturing feedstock (3% sulfur).